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Records of Cladocera (Crustacea) from the South-West Province of Australia.

(With one Plate IX.)

BY

D. L. SERVENTY.

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With the exception of a single species—*Moina flexuosa*, Sars—described from Roebourne, the Western Australian fresh-water Cladocerans have up to the present time remained quite unknown. Since the Rev. R. L. King commenced the study of the Australian forms with the description of a number of New South Wales Cladocerans in the Proceedings of the Royal Society of Van Diemen's Land, 1853, the Eastern Australian members of the group have received the attention in turn of the late Professors J. D. Dana and G. O. Sars, the late Geoffrey Smith, and Miss Marguerite Henry, with the result that the total number of species was raised to 73, made up as follows: Sididae, 2 species; Daphnidae, 23; Macrothricidae, 7; Bosminidae, 4; Chydoridae, 37. Contributions to the geographical distribution of the group were also made by J. F. Haase, G. I. Playfair and J. Searle, and a valuable monograph of the species occurring in New South Wales, with lists of all the Australian forms, was published by Miss Henry in 1922.

The several memoirs of the late G. O. Sars, which are notable contributions to the study of the Australian Cladocerans were for the most part based on material hatched out in aquaria prepared with dried mud sent to him in Norway by Australian zoologists. These contributors included the late O. A. Sayce and T. Whitelegge, and J. Searle, and in New Zealand the Hon. G. M. Thomson and Professor C. Chilton.

In the present paper is recorded the occurrence of five species of the family Daphnidae from the South-West of this State. A new species is described and referred to the genus *Daphniopsis* of Sars, known heretofore only from Asia and Kerguelen Island in the Sub-Antarctic.

Most of the collecting for the purpose of the paper was made in the pools and swamps in the clays at Cannington during 1926 and 1927, and collecting trips have been made to Jandakot and Welshpool. Tubes of preserved material have also been received from Messrs. L. Glauert (Rottnest), W. H. Mathews (Rottnest and Bunbury) and D. C. Swan (Welshpool). My thanks are due to these friends for their interest, and also to Miss Henry (now Mrs. A. G. S. Cooper), of Sydney, for much generous advice and assistance, to Mr. J. Searle of Melbourne, for specimens and papers, to the late Professor G. O. Sars—doyen of modern carcinologists—for a set of some of his papers, to Mr. Glauert again for assistance with literature and to Mr. C. A. Gardiner for the production of the accompanying plate from my camera-lucida drawings.

Class CRUSTACEA.

Sub-class BRANCHIOPODA.

Order CLADOCERA.

Family DAPHNIDAE.

Genus **DAPHNIA**, O. F. Muller.**Daphnia Thomsoni**, Sars.

Daphnia similis, G. M. Thomson (not Claus).

Daphnia thomsoni, G. O. Sars, Contributions to the knowledge of the Freshwater Entomostraca of New Zealand, *Christ. Vid. Selsk. Skrifter* f. 1894, p. 5, pl. i.

This species was originally described in New Zealand as *Daphnia similis* by the Hon. G. M. Thomson and was renamed *D. thomsoni* by the late Professor G. O. Sars owing to the *D. similis* of Claus—an Asiatic species—having priority to the name. In 1895 Sars found it to occur in South Africa, he having reared it in aquaria from mud obtained at Knysna, in Cape Province. It is figured in his Freshwater Entomostraca of Cape Province. (9).

The present record appears to be the first for Australia. Professor Chilton's remark that *D. thomsoni* is known to occur in Australia (2, p. 482) may be attributed perhaps to his sharing the view of Dr. J. Richard that *D. thomsoni* is a variety of *D. carinata*—the common Eastern States' form—a view which is not entertained by other workers. (8).

The post-abdomen of this species has the posterior or dorsal margin clearly sinuate, and armed with 11 to 14 well-marked anal spines. The sinuosity of this margin distinguishes the species from the closely related *D. carinata*, King, and Sars remarks on the resemblance of *D. thomsoni* to the European and South African species, *D. magna*, Straus, in respect of this feature.

I found the form to be extremely abundant in an open lake-like freshwater swamp on the Pipe Track, three miles to the south-east of the Cannington railway station. The colour of these animals was pale green. In 1927 hazel or light chestnut individuals were present in relatively enormous numbers in a small pond adjoining the swamp and containing water stained with decaying vegetation. The carapace varied to some extent imparting to some specimens an appearance of enlarged size. I also collected the species in Lake Yangebup, near Jandakot, and have detected it in collections from Bunbury (W. H. Mathews), Welshpool (D. C. Swan), and from Rottneest Island (L. Glauert), the last-named specimens being taken from a pool south of The Basin in September, 1927, whence also the *Daphniopsis* (*infra*) had been collected two years previously. Sufficient collecting has not yet been undertaken to state it as a fact, but it would appear that *D. thomsoni* is the common *Daphnia* of the South-West.

Daphnia Carinata, King.

Daphnia carinata, R. L. King. On some species of Daphniadae found in New South Wales. *Papers and Proceedings of the Royal Society of Van Dieman's Land*, Vol. II, pt. II. (1853), p. 246. G. O. Sars, *Daphnia carinata* King, and its Remarkable Varieties, *Arch. Math. og Naturvid. Bd. XXXIV.*, No. 1 (1914).

Specimens of this common Eastern Australian *Daphnia* were taken by me in a small pool in the valley of the Irwin River near Nangetty Station, some 35 miles north-east of Dongarra, during Professor E. de C. Clarke and party's visit there in August of this year.

The specimens somewhat resemble King's variety *gravis*, as illustrated by Sars (8), but do not reach the maximum size of 5 mm. which is given for that variety, the Nangetty examples measuring up to 4.1 mm. The frontal edge of the head is evenly curved as in Sars's variety *intermedia*, the tip of the rostrum projecting as a hook. The posterior spine is slender and markedly upcurved. The ventral margin of the shell is roundly curved. Nine to about fourteen anal denticles are borne on the post-abdomen. Both ephippia

and parthenogenetical females were present, the individuals varying considerably in size.

Genus **DAPHNIOPSIS**, Sars, 1903.

Of this interesting genus only two species have hitherto been recognised, and a third is now described. It was erected by Sars in 1903 to take a new species, *Daphniopsis tibetana*, collected in Toso Nor, Tibet, and in the North-West of Mongolia, which he considered to exhibit characters intermediate between *Daphnia* and *Simosa*. It resembled *Daphnia* in the shape of the ventral part of the head and the structure of the antennulae and antennae, and was like *Simosa* in the shape of the fornix and in the absence of either a dorsal carina or a posterior spine. Only parthenogenetical females were examined.

In 1914 F. E. Ruhe, working on the freshwater crustacea collected by the German South Polar Expedition of 1901-1903, described a second species of *Daphniopsis* from Kerguelen Island. The animal was named *D. studeri* and was stated to be identical with a species described by T. Studer from Kerguelen Island in 1878 (Über eine Fauna von Süsswassererustaceen in Kerguelensland. *Arch. f. Naturgesch. Jahrg.* 44) as *Simocephalus intermedius*, which name was invalidated through the Law of Priority. After a detailed morphological examination of *D. studeri*, Ruhe stated that the resemblances of the genus *Daphniopsis* to *Simosa* were entirely superficial and that its true affinities lay with *Daphnia*. From evidence adduced particularly from a study of the structure of the legs, he claimed that Sars's view that *Daphniopsis* occupied an intermediate position between *Simosa* and *Daphnia* could not be sustained.

"I come to the conclusion," he wrote, "that *Daphniopsis* is no phylogenetic transitional form between *Daphnia* and *Simosa*, but a genus which is united in the most intimate manner to *Daphnia*" (translation). He concluded that of the two existing species *Daphniopsis tibetana* appeared to be an older form because of the *Daphnia*-like type of the ventral contour of the head and rostrum, and of the abdominal appendages, and that *D. studeri* might have been derived from it.

The species described hereunder and named *Daphniopsis pusilla*, bears resemblances to both of the existing species but is quite distinct from either.

Daphniopsis Pusilla, sp., nov.

Description.—Ehippial female: Carapace, seen laterally, ovoid, robust, with the greatest width somewhat posterior to the minor axis. Head defined from the carapace dorsally by a well-marked depression. Dorsal margin rounded, ocular region protuberant with a concavity both above and below the eye. Rostrum prominent, somewhat deflexed. Fornix evenly curved and extending to the ocular region. Ehippium boldly curved and from its posterior extremity it arches with a slight concavity to the obtuse but well-marked posterior protuberance, thence arching convexly to a more or less well-defined infero-posteral angle. Free edges of valves smooth, surface of shell marked with quadrangular, pentagonal and hexagonal reticulations. Eye large, with crystalline bodies fairly well indicated. Ocellus punctate, occurring midway between the eye and the base of the labrum. Antennulae clearly projecting beyond the rostrum. Post-abdomen narrowly conical, with posterior margin evenly convex. Apical claws of moderate size, evenly curved and each armed with a row of fine spinules. Anal spines very small and about twelve in number. The dorsal processes are not well-marked in the preserved specimens and they are evident only as three conical bulges. Hepatic caeca prominent, coiled.

Male.—Much smaller than the ehippial female, and more slender and elongated. Carapace, seen laterally, of narrow oblong form. Dorsal margin curved but almost straight. Posterior protuberance well-marked but infero-posteral angle absent. Head distinctly divided from carapace and not nearly so procumbent as in the female. Eye large. Antennulae, as is usually the case, elongated, each with a terminal flagellum longer than the base of the antennule. First pair of legs terminating in long setae. The post-abdomen like that of the female in form, but narrower and with posterior margin nearly straight.

Colour (in spirit).—Dark brown, translucent. Ehippium black, some specimens showing a brown zoning.

Length.—Female, 1.9 mm.; male, 1.25 mm.

Locality.—Rottnest Island (W. H. Mathews, November, 1925).

Affinities.—The present form differs from the type species of the genus *D. tibetana*, in a number of features. It is difficult to compare the general form of ehippial with parthenogenetical individuals, and the more vaulted appearance of the dorsal margin of the carapace of *Daphniopsis pusilla* is no doubt due to the outbulging of the ehippium. The posterior margin of the ventral edge of the carapace is more fully curved and there is a fairly distinct infero-posteral angle which is absent in *D. tibetana*. The general outline of the carapace varies somewhat and I have broadly ovoid specimens, with extremely vaulted ehippia, recalling members of the genus *Moina* in appearance. The rostrum is not sharply pointed downward as in *D. tibetana*, but is rather obtuse. Though generally evenly rounded, the posterior margin of the post-abdomen is sometimes found with a more or less distinct sinus. The anal spines, usually 12 in number, are about equal in size, and in some individuals may be differentiated into a posterior (distal) series of eight small spines and an anterior set of four larger ones divided off from the former by a small space. The apical claws differ in being denticulated. Finally *D. tibetana* is larger, though evidence on this point is inconclusive as ehippial females are normally inferior in size to parthenogenetical individuals.

In some of the characters in which *D. pusilla* differs from *D. tibetana* it shows agreement with *D. studeri*. Both of the southern species possess the blunt rostrum somewhat resembling that of *Simosa*, but the likeness is rather less close in the case of *D. pusilla*. The resemblances extend to the general shape of the post-abdomen, and the denticulations of the apical claws. *D. pusilla* differs, however, in the possession of only one ehippial egg (there are two in *D. studeri*), in the more vaulted appearance of the dorsal margin of the carapace, in the smooth edges to the carapace, and in the lesser number of anal spines of which there are about 20 in *D. studeri*. Moreover there is no suggestion in any of the females of *D. pusilla* examined, or in the males, of the production of the dorsal protuberance into a small spine, which is the case in young females and males of *D. studeri*. The male of *D. pusilla* differs from the male of *D. studeri* in the fact that the head is extended, whilst in the latter species the head appears to be almost as procumbent as in the female. *D. pusilla* is slightly smaller than *D. studeri*, the female of which measures 2.1 to 2.35 mm., and the male 1.37 to 1.74 mm.

The difference in the number of ehippial eggs in the two forms is interesting. *D. tibetana* cannot be compared in respect of this feature as no ehippial females have been described. Two ehippial eggs are characteristic of the genus *Daphnia*, and one of *Simosa*.

The credit for the discovery of this exceptionally interesting form lies with Mr. W. H. Mathews, who took a large gathering of specimens in a pool in Rottneest Island during November, 1925. Ehippial females alone appeared to be present of that sex, with large numbers of males. The pool, which dries up in the summer, is located at the north-eastern end of the island, south of The Basin and just north of the series of salt lakes. The water, though not fresh, is potable but noticeably mineralised.

Distribution.—The presence of a species of *Daphniopsis* in this State is a matter of considerable interest, though what light its occurrence may shed on problems of zoogeography cannot in the present state of knowledge of the distribution of the genus be properly appreciated.

The negative evidence afforded by its extreme rarity in collections suggests that the genus may not be widely ranging and therefore that it may be of more interest from the zoogeographical point of view than the majority of Cladocera.

Considering first the case of *Daphniopsis tibetana* and *D. pusilla* one might be tempted to ascribe to migratory wading birds an explanation of the discontinuous range of the genus. The possibility of eggs of the minute crustacea as well as of other forms of life, being transported from place to place in pellets of mud attached to the feet of Limicoline birds, or in their feathers, is an ever-present one. Several species of migratory wading birds breeding in Northern Asia winter in Australia, and incidentally, it may be stated are particularly abundant on the Rottneest Lakes.

The case of Kerguelen Island, however, raises an objection to the theory of transference thither of the *Daphniopsis* by birds, at least in recent times. This isolated island is visited by no migratory birds, save members of the petrel order, such as albatrosses, whose importance in the present connection may, I think, be discounted because their habits are pelagic except during the breeding season. The only wader is a resident *Chionis*. What the condition may have been in the past is unknown, but it would appear from the existing evidence that *D. studeri* is a long established resident on the island. This cannot be stated unequivocally of *D. pusilla*, but should such be the case one might venture a hypothesis accounting for the present distribution of the genus by regarding *D. pusilla* as an Antarctic element in the South-West fauna, separated from its congener in Kerguelen Island through the dismemberment of the so-called Gondwanaland (Australia, Antarctica, South Africa, South America and India). Birds might later have played a subsidiary part in affecting the intra-continental ranges of the members of the genus.*

Genus **SIMOSA**, Norman.

This genus was originally established under the name of *Simocephalus* by Schoedler in 1859 and was renamed *Simosa* by Canon A. M. Norman in 1903 owing to the earlier one being pre-occupied. The members of it are laboured swimmers, progressing frequently with the ventral surface uppermost. A characteristic habit of constantly flicking the post-abdomen aids a naked-eye identification of these forms in the field. They seem to favour weedy pools and swamps.

* The distribution of the genus *Daphniopsis* closely corresponds with that of the freshwater Copepoda of the family Boeckellidae, which has an extended circum-austral range in South America and the neighbouring islands, Australia and New Zealand. One species, *Pseudoboeckella brevicaudata* (Brady) occurs in Kerguelen Island, several species of *Boeckella* are found in Western Australia, and *Boeckella orientalis* (Sars) occurs in Mongolia. Other than the last-named, the members of this family do not extend beyond southern temperate and sub-antarctic latitudes, except at high levels in the Andes.

Simosa Australiensis, Dana.

Daphnia australiensis, Dana, Report of the United States Exploring Expedition, *Crustacea II*, 1853, p. 1271, pl. 89, figs. 4a-e.

Simocephalus australiensis, G. O. Sars, Additional Notes on Australian Cladocera, *Christ. Vid. Selsk. Forhandl. f.* 1888, No. 7, p. 15, pl. 2, figs. 1-5.

Professor Dana described this species from New South Wales, since when it has been collected widely in that State, also in Queensland and South Australia (Henry), Tasmania (G. W. Smith) and South Africa (Sars). Professor Sars considers it to be closely allied to the European species, *S. exspinosa* (de Geer), and suggests that its validity as a distinct species appears somewhat questionable. (9)

Specimens of this form occurred abundantly in the clay flats to the west of the Cannington railway station, being found in most of the holes and pools during the winter. These pools were clear of silt and debris and had comparatively little vegetation growing in them, the Cladocerans being bright green in colour. In December, 1927, I collected the species, in company with *S. gibbosa*, in a swamp in the sandy part of Welshpool, the water being full of vegetation, silty and of the usual dark colour. In this case the creatures were brown.

Simosa Gibbosa, Sars.

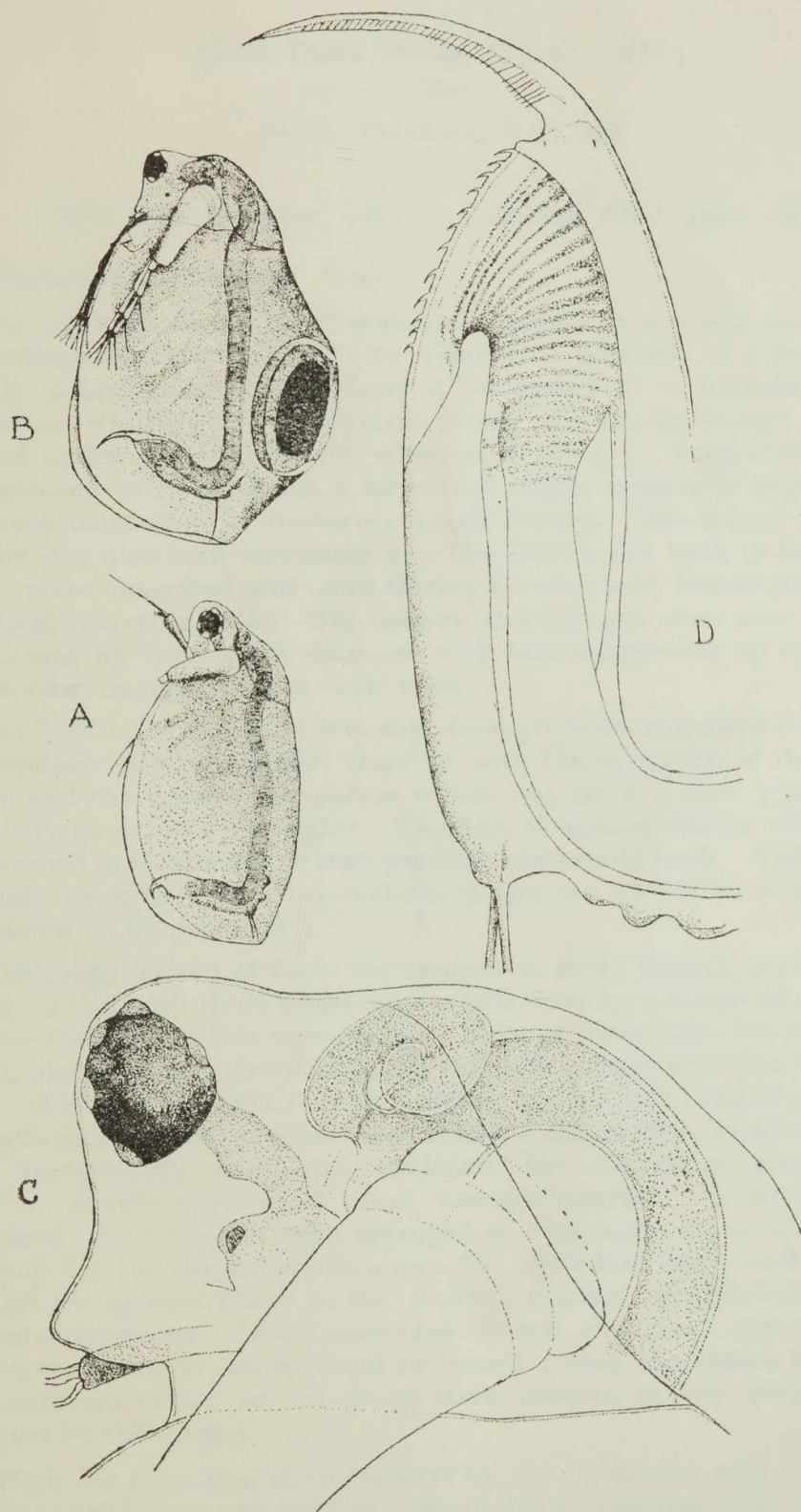
Simocephalus gibbosus, G. O. Sars. On Freshwater Entomostraca from the neighbourhood of Sydney, *Arch. Math. og Naturvid.*, Bd. XVIII., No. 2.

This species was founded on material obtained at Centennial Park, Sydney, and the only other place in New South Wales where it has been collected is Botany (Henry). J. Searle has recorded it from Victoria and I have specimens from him. I collected the form in December, 1927, in the swamp at Welshpool mentioned under the previous species, it occurring rather sparingly in the shallows amongst the alga *Nitella*. The animals were brown in colour and were parthenogenetical females. My specimens have the apical claws not smooth but with the concave edge bordered with a row of very fine spinules.

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PLATE IX.



Daphniosis pusilla, sp., nov.

A, male; B, parthenogenetical female; C, head of female, enlarged;
D, post-abdomen of female, enlarged.